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(54) Name of the invention:

Electret

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[Note: Names, addresses, company names and brand names are translated in the most common manner. Japanese language does not have singular or plural words unless otherwise specified by a numeral prefix or a general form of plurality suffix.]

(54) [Name of the Invention]

Electret

(57) [Abstract]

[Topic]

The topic of the present invention is to suggest an electret, which even under high temperature and high humidity has low electrical charge attenuation and excellent holding properties.

[Solution Measures]

An electret formed by the electretization of ionomer, obtained as 10 ~ 100 % of the carboxylic radicals of ethylene – unsaturated carboxylic acid copolymer where the unsaturated carboxylic acid content is in the range of 1 ~ 30 weight %, is neutralized by alkaline earth type metal ion.

Also, an electret is formed by the electretization of a resin composition material consisting of 1 ~ 99 weight parts of the above described ionomer, and of 99 ~ 1 weight parts of another thermoplastic resin.

[Scope of the Claims]

[Claim 1]

An electret formed by the electretization of ionomer, obtained as 10 ~ 100 % of the carboxylic radicals of ethylene – unsaturated carboxylic acid copolymer where the unsaturated carboxylic acid content is in the range of 1 ~ 30 weight %, is neutralized by alkaline earth type metal ion.

[Claim 2]

An electret formed by the electretization of a resin composition consisting of ionomer, obtained as 10 ~ 100 % of the carboxylic radicals of ethylene – unsaturated carboxylic acid copolymer where the unsaturated carboxylic acid content is in the range of 1 ~ 30 weight %, is neutralized by alkaline earth type metal ion, in an amount in the range of 99

~ 1 weight %, and of another thermoplastic resin in an amount in the range of 99 ~ 1 weight parts.

[Detailed Description of the Invention]

[0001]

[Technological Field of the Invention]

The present invention is an invention about electret with excellent long term electrical charge holding properties.

[0002]

[Prior Art]

Electrets formed as polymeric compounds are electrically charged have been widely used in dustproof filters, audio elements etc. The fact that ionomers can be utilized as such polymeric compounds that can be used for such applications, is already known as it has been disclosed according to the report described in the Japanese Patent Application Laid Open Number Showa 51-48278. In more details, the fact that it is possible to use ionomers, which have sodium or zinc ion source, has been disclosed, and it has been shown that the change of the surface electrical charge with the passing of the time, is small. However, in practice, in many applications, it is required that the change of the surface electrical charge with time be small even under high temperature and high humidity environments, and with respect to this point, it has been concluded that when sodium or zinc ionomers are used, sufficient performance is not obtained.

[0003]

In the description reported in the Japanese Patent Application Laid Open Number Showa 51-48278 it has also been reported that as the polymeric compound used for the electret, it is also a good option if together with the polyolefins modified by using unsaturated carboxylic acids or their derivatives ionomer resins, are used. However, there is no detailed statement at all regarding the ionomer resins.

[0004]

[Problems Solved by the Present Invention]

It is known that the ionomer resins are resins possessing excellent properties like transparency properties, oil resistance properties, and other different types of properties, and also, that it is possible to control these properties through the content of the unsaturated carboxylic acids and the degree of neutralization. Then, the authors of the present invention have conducted studies to improve the drawback points of the sodium and zinc ionomers described according to the description reported in the Japanese Patent

Application Laid Open Number Showa 51-48278, in order to suggest electret material, which embodies such properties. As a result from that it was found that by the use of a material, which has an alkaline earth type metal as the ion source, for the ionomer material, it is possible to achieve this goal, and by that the present invention was achieved. Consequently, the present invention is an invention, which suggests an electret that is manufactured from ionomers, and that has improved long term electrical charge holding properties.

[0005]

[Measures in Order to Solve the Problems]

The present invention is an invention about an electret formed by the electretization of ionomer, obtained as 10 ~ 100 % of the carboxylic radicals of ethylene – unsaturated carboxylic acid copolymer where the unsaturated carboxylic acid content is in the range of 1 ~ 30 weight %, is neutralized by alkaline earth type metal ion. And also, the present invention is an invention about an electret formed by the electretization of a resin composition consisting of ionomer, obtained as 10 ~ 100 % of the carboxylic radicals of ethylene – unsaturated carboxylic acid copolymer where the unsaturated carboxylic acid content is in the range of 1 ~ 30 weight %, is neutralized by alkaline earth type metal ion, in an amount in the range of 99 ~ 1 weight %, and of another thermoplastic resin in an amount in the range of 99 ~ 1 weight parts.

[0006]

[Practical Embodiment of the Present Invention]

As the base polymer of the ionomer, which is used according to the present invention and which has alkaline earth type metal ions as the ion source, there are the ethylene unsaturated copolymer materials, where the content of the unsaturated carboxylic acid is in the range of 1 ~ 30 weight parts, and preferably, it is in the range of 5 ~ 25 weight parts, and it is possible to use not only ethylene and unsaturated carboxylic acid two component copolymers, but also, it is a good option if multi-component copolymer materials, where any other monomer material has been copolymerized, are employed.

[0007]

Here, as the unsaturated carboxylic acid, it is possible to list as examples, acrylic acid, methacrylic acid, ethacrylic acid, maleic acid, fumaric acid, itaconic acid, anhydrous maleic acid, monomethyl maleate, monomethyl maleate, etc. And especially, acrylic acid or methacrylic acid, are preferred.

[0008]

As the above described other monomer material that can be optionally copolymerized it is possible to list the following materials as examples: vinyl acetate, vinyl propionate,

etc., vinyl esters, methyl acrylate, ethyl acrylate, isopropyl acrylate, isobutyl acrylate, n-butyl acrylate, isooctyl acrylate, 2-ethyl hexyl acrylate, methyl methacrylate, ethyl methacrylate, isobutyl methacrylate, dimethyl maleate, diethyl maleate, etc., unsaturated carboxylic acid esters, carbon monoxide, sulfur dioxide, etc. These other monomer materials, can be optionally compounded, for example, in an amount that is within the range of 0 ~ 40 weight %, and preferably, within the range of 0 ~ 30 weight %.

[0009]

As such base polymer, it is preferred to use materials whose melt flow rate at a temperature of 190°C and a load of 2160 grams, is in the range of 0.1 ~ 10000 g/10 minutes, and preferably in the range of 1 ~ 3000 g/10 minutes.

[0010]

According to the present invention, materials are used where 10 ~ 100 %, and preferably, 20 ~ 90 %, and especially preferably, 30 ~ 80 % of the carboxylic radicals of such ethylene unsaturated carboxylic acid copolymer materials, have been neutralized by alkaline earth type metal ions. Here, as the alkaline earth type metal ions used, there are magnesium, calcium, strontium, etc., and especially, magnesium is the most preferred. If instead of such alkaline earth type metal ions, lithium, sodium, potassium etc., alkali metals or zinc etc., neutralization materials, are used, it is not possible to obtain electrets with excellent long-term electrical charge holding properties. As the ionomer, if the molding processing properties, the properties of the molded materials, etc., are considered, it is preferred to use materials whose melt flow rate at a temperature of 190°C and a load of 2160 grams is in the range of 0.01 ~ 1000 g/10 minutes, and especially, those where it is in the range of 0.1 ~ 500 g/10 minutes.

[0011]

According to the present invention it is possible that the material obtained as the above described alkaline earth type metal ionomer is electretized only by itself, be used, however, optionally, also a material, obtained as any other thermoplastic resin is compounded, can be used as the raw material for the electretization. As such other thermoplastic resin, it is possible to list the following materials as examples: different types of polyethylene, polypropylene, poly - 1- butene, poly - 4- methyl - 1- pentene, etc., polyolefins, ethylene - vinyl acetate copolymers, ethylene (meth)acrylic acid copolymers, ethylene (meth)acrylic acid ester copolymers, ethylene vinyl alcohol copolymers, etc., ethylene type copolymers, polyesters, polyamides, polycarbonates, polystyrenes, ABS type resins, polyvinyl chlorides, polyvinylidene chlorides, polyphenylene oxides, polyacetal, polysulfone, polyimide, natural rubber, synthetic rubber, etc. Regarding the compounding ratio of the alkaline earth type metal ionomer and this other thermoplastic resin material, for example, the former is within the range of 1 ~ 99 weight parts, and preferably, it is within the range of 50 ~ 99 weight parts, and the latter is within the range of 99 ~ 1 weight parts, and preferably, it is within the range of 50 ~ 1 weight parts.

[0012]

In the electretization of the alkaline earth type metal ionomer or of the compounded material obtained from that and the other thermoplastic resin material, it is possible to also compound different types of additive agents. As such additive agents, it is possible to compound antioxidation agents, thermal stabilization agents, ultraviolet light absorbing agents, light stabilization agents, dyes, pigment materials, flame retardants, anti-blocking agents, plasticizer agents, tackifiers, oils, electrical charge regulating agents, reinforcing materials, inorganic filler agents, etc.

[0013]

The electretization can be conducted according to the well known methods, like for example, the thermal electretization method, the electro-electretization method, the radio-electretization method, the mechano-electretization method, etc. These can be conducted prior to the molding, simultaneously with the molding, or after the molding. Also, depending on the molding conditions, there is spontaneous charging, and in such cases, it is possible to eliminate the electrical charge treatment.

[0014]

[Results From the Present Invention]

The electret according to the present invention, even under high temperature and high humidity, has low electrical charge attenuation and has excellent properties. Consequently, it can be advantageously used in shapes such as a fiber shape, film shape, sheet shape, tubular shape, pipe shape, powder form, etc. Also, it is possible to be used as woven or nonwoven fabric, or other materials, for example, as a laminated material where it is laminated with thermoplastic resin. The obtained by that electret molded product has excellent long-term electrical charge holding properties and it also has the excellent properties, which are inherent to the ionomers, and because of that, it is a material that can be used in dustproof filters, microphones etc., audio elements, measurement elements, recording elements, recording materials, coating materials, medical materials, etc.

[0015]

[Practical Examples]

After that the present invention will be explained by using practical implementation examples. Moreover, raw materials used in the practical examples and the reference examples and the evaluation methods of the different properties, are according to the below described.

[0016]

1. Raw Materials

(1) Base polymer of the ionomer

The materials shown according to Table 1, are used.

[0017]

[Table 1]

	Copolymer Composition		MFR (g/10 minutes)
	Type of the unsaturated carboxylic acid	Compounded Amount (weight %)	
Acid Copolymer (1)	Methacrylic acid	9	10
Acid Copolymer (2)	Methacrylic acid	10	35
Acid Copolymer (3)	Methacrylic acid	15	60
Acid Copolymer (4)	Methacrylic acid	20	60

[0018]

(2) Thermoplastic resin compounded to the ionomer

Polypropylene: Manufactured by Mitsui Chemicals Inc.
MFR: 10 g/10 minutes (230oC)

[0019]

(3) Organic amine used in the neutralization

NBDA: Manufactured by Mitsui Toatsu Chemicals Inc.
2, 5 (2, 6) – bis (aminomethyl) bicyclo [2, 2] heptane

[0020]

2. Property Evaluation Methods

- (1) MFR: The evaluation is conducted according to the regulations of the JIS K7210, at a temperature of 190oC and a load of 2160 grams. However, the thermoplastic resin 1 was evaluated at a temperature of 230oC and a load of 2160 grams.

[0021]

(2) Retention of the surface charge density

(a) Equipment

Measurement equipment: Surface charge density measurement device, manufactured by the Institute for Physical and Chemical Research (RIKEN).

Charge equipment:

Electrical source: Direct current charge electrical voltage source (manufactured by Matsutei Predishon Company)

Electrode: minus – needle shape electrode, stainless steel plate ground electrode

[0022]

(b) Electrical charging conditions

Temperature:	25oC
Electrical voltage:	-7 kV
Charge time:	30 sec.
Electrode distance:	10 mm
Test specimen dimensions:	80 x 220 x 0.05 mm sheet

[0023]

© Measurement Method

The film is electrically charged and after that it is placed between aluminum plates and shorted and the unstable surface electrical charge is eliminated, and it is left to stand at room temperature for 1 hour, and the surface charge density, measured by the surface charge density measurement equipment, is taken as the initial value. After that, the above described sample is placed in a constant temperature and constant humidity chamber and it is left to stay for 24 hours at a temperature of 60oC and an RH of 80 %, and after that the surface charge density is measured, and from the ration of that and the above described initial value, the retention of the surface charge density was obtained, and the stability properties of the electret film, were evaluated.

[0024]

[Practical Example 1]

Inside a vented type single screw extruder (screw diameter 65 mm, L/D=33), the acid copolymer material (2) was ionized through a magnesium source, and magnesium ionomer with a neutralization level of 80 mol %, was obtained. The obtained magnesium ionomer was formed into a film by using an inflation film forming device, and it was

electrically charged, and after that according to the above described method (2), the retention of the surface charge density, was measured. The results are shown according to the presented in table 3.

[0025]

[Practical Examples 2, 3]

The magnesium ionomer, obtained according to the Practical Example 1, where instead of the base resin acid copolymer material (2), the acid copolymer material (3), was used, and an ionization was conducted by using magnesium source at a neutralization level shown according to the presented in Table 2, was formed as a film with the predetermined shape the same way as in the case of the Practical Example 1, and it was electrically charged, and after that the retention of the surface charge density was measured according to the above described method. The results are shown according to the presented in Table 3.

[0026]

[Practical Examples 4 ~ 6]

A resin composition material obtained as the same magnesium ionomer and the same polypropylene (manufactured by Mitsui Petro-Chemicals Company) as those used according to the Practical Example 3 above were used and these were melted and mixed at the compounding ratios shown according to Table 2, was formed as a film with the predetermined shape, by using an inflation film forming equipment, and after that the retention of the surface charge density was measured according to the above described method. The results are shown according to the presented in Table 3.

[0027]

[Reference Examples 1 ~ 4]

Each of the zinc ionomers with the neutralization levels shown according to Table 2, obtained when as the base resins, the acid copolymer materials (1) ~ (4) were correspondingly used, and instead of the magnesium source, zinc source was used and these were ionized, were formed as a film with the predetermined shape by using an inflation film forming equipment, and after that the retention of the surface charge density was measured according to the above described method, however, the retention coefficients were low compared to those obtained in the case of the practical examples. The results are shown according to the presented in Table 3.

[0028]

[Reference Example 5]

A sodium ionomer material with a 52 mol % neutralization level, which is obtained when the acid copolymer material (3) was used as the base polymer, and where the ionization was conducted by using sodium source instead of the magnesium, was formed as a film with the predetermined shape by using an inflation film forming equipment, and after that the retention of the surface charge density was measured according to the above described method, however, the retention coefficients were low compared to those obtained in the case of the practical examples. The results are shown according to the presented in Table 3.

[0029]

[Reference Example 6]

An amine ionomer material with a 80 mol % neutralization level, which is obtained when the acid copolymer material (3) was used as the base polymer, and where the ionization was conducted by using the amine compound NBDA, reported according to the above described (3), was formed as a film with the predetermined shape by using an inflation film forming equipment, and after that the retention of the surface charge density was measured according to the above described method, however, the retention coefficients were low compared to those obtained in the case of the practical examples. The results are shown according to the presented in Table 3.

[0030]

[Table 2]

	Ionomer			Thermoplastic Resin	Ionomer/Thermoplastic Resin Compounding Ratio
	Base Resin	Ion Type	Neutralization Level, Mol %		
Practical Example 1	Acid Copolymer (2)	Mg	80	-----	-----
Practical Example 2	Acid Copolymer (3)	Mg	40	-----	-----
Practical Example 3	Acid Copolymer (3)	Mg	60	-----	-----
Practical Example 4	Acid Copolymer (3)	Mg	60	Polypropylene	3/1
Practical Example 5	Acid Copolymer (3)	Mg	60	Polypropylene	1/1
Practical Example 6	Acid Copolymer (3)	Mg	60	Polypropylene	1/3
Reference Example 1	Acid Copolymer (1)	Zn	18	-----	-----
Reference Example 2	Acid Copolymer (2)	Zn	68	-----	-----
Reference Example 3	Acid Copolymer (3)	Zn	58	-----	-----

Reference Example 4	Acid Copolymer (4)	Zn	40	-----	-----
Reference Example 5	Acid Copolymer (3)	Na	52	-----	-----
Reference Example 6	Acid Copolymer (3)	Zn	80	-----	-----

[0031]

[Table 3]

	Surface Charge Density (x 10 ⁻⁹ C/cm ²)		
	Initial Value	After Aging	Retention Coefficient, %
Practical Example 1	17.3	12.8	74
Practical Example 2	17.4	11.2	64.4
Practical Example 3	22.4	15.4	69
Practical Example 4	11.4	5.9	51.8
Practical Example 5	11.5	4.8	41.7
Practical Example 6	7.4	4.9	66.2
Reference Example 1	19.4	3.2	16.5
Reference Example 2	20.4	6.7	32.8
Reference Example 3	23	2.6	11.3
Reference Example 4	21.8	2.5	12
Reference Example 5	24.4	1.5	5.9
Reference Example 6	23.3	0.1	0

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(54) 【発明の名称】 エレクトレット

(57) 【要約】

【課題】 高温、高温下においても、電荷の減衰が少なく、保持性に優れたエレクトレットの提供

【解決手段】 不飽和カルボン酸含有量が1~30重量%のエチレン・不飽和カルボン酸共重合体のカルボキシ基の10~100%がアルカリ土類金属イオンにより中和されたアイオノマーをエレクトレット化してなるエレクトレット。

また上記アイオノマー・・・・・・1~99重量部と他の熱可塑性樹脂・・・・・・99~1重量部を配合してなる樹脂組成物をエレクトレット化してなるエレクトレット。

【特許請求の範囲】

【請求項1】 不飽和カルボン酸含有量が1～30重量%のエチレン・不飽和カルボン酸共重合体のカルボキシル基の10～100%がアルカリ土類金属イオンにより中和されたアイオノマーをエレクトレット化してなるエレクトレット。

【請求項2】 不飽和カルボン酸含有量が1～30重量%のエチレン・不飽和カルボン酸共重合体のカルボキシル基の10～100%がアルカリ土類金属イオンにより中和されたアイオノマー1～99重量部と他の熱可塑性樹脂99～1重量部を配合してなる樹脂組成物をエレクトレット化してなるエレクトレット。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、電荷の長期保持性の優れたエレクトレットに関する。

【0002】

【従来の技術】高分子化合物を荷電させたエレクトレットは、防塵フィルターや音響素子などに広く使用されている。このような目的に使用される高分子化合物としてアイオノマーが使用できることは、特公昭51-48278号公報においてすでに知られている。具体的には、ナトリウム又は亜鉛をイオン源とするアイオノマーが使用できることが開示されており、表面電荷の経時変化が小さいことが示されている。しかしながら実用的には、多くの用途において高温多湿下においても表面電荷の経時変化が小さいことが求められており、この点において、ナトリウムアイオノマーや亜鉛アイオノマーでは十分な性能を有していないことが判明した。

【0003】特公昭59-23098号公報においても、エレクトレット用高分子化合物として、不飽和カルボン酸またはその誘導体で変性されたポリオレフィンとともに、アイオノマー樹脂が配合使用されてもよいと記載されているが、アイオノマー樹脂に関して詳細な記載は一切なされていない。

【0004】

【発明が解決しようとする課題】アイオノマーは、透明性、耐油性、その他種々の優れた性能を有する樹脂として知られており、またその不飽和カルボン酸含有量や中和度によってこれら性能をコントロールできる。そこで本発明者らは、このような特性を生かしたエレクトレット材料を提供すべく、特公昭51-48278号公報に記載されたナトリウムや亜鉛のアイオノマーの欠点を改良するための検討を行った。その結果、アイオノマーとしてアルカリ土類金属をイオン源とするものを用いることにより、その目的が達成できることを知り、本発明に到達した。したがって本発明は、電荷の長期保持性の改良されたアイオノマー製エレクトレットを提供することにある。

【0005】

【課題を解決するための手段】本発明は、不飽和カルボン酸含有量が1～30重量%のエチレン・不飽和カルボン酸共重合体のカルボキシル基の10～100%がアルカリ土類金属イオンにより中和されたアイオノマーをエレクトレット化してなるエレクトレットに関する。本発明はまた、不飽和カルボン酸含有量が1～30重量%のエチレン・不飽和カルボン酸共重合体のカルボキシル基の10～100%がアルカリ土類金属イオンにより中和されたアイオノマー1～99重量部と他の熱可塑性樹脂99～1重量部を配合してなる樹脂組成物をエレクトレット化してなるエレクトレットに関する。

【0006】

【発明の実施の形態】本発明で用いられるアルカリ土類金属をイオン源とするアイオノマーのベースポリマーとしては、不飽和カルボン酸含有量が1～30重量%、好ましくは5～25重量%のエチレン・不飽和カルボン酸共重合体であり、エチレンと不飽和カルボン酸の二元共重合体のみならず、任意に他の単量体が共重合された多元共重合体であってもよい。

【0007】ここに不飽和カルボン酸としては、アクリル酸、メタクリル酸、エタクリル酸、マレイン酸、フマル酸、イタコン酸、無水マレイン酸、無水イタコン酸、マレイン酸モノメチル、マレイン酸モノエチルなどを例示することができる。とくに好ましいのは、アクリル酸又はメタクリル酸である。

【0008】上記任意に共重合されていてもよい他の単量体としては、酢酸ビニル、プロピオン酸ビニルのようなビニルエステル、アクリル酸メチル、アクリル酸エチル、アクリル酸イソプロピル、アクリル酸イソブチル、アクリル酸nブチル、アクリル酸イソオクチル、アクリル酸-2-エチルヘキシル、メタクリル酸メチル、メタクリル酸エチル、メタクリル酸イソブチル、マレイン酸ジメチル、マレイン酸ジエチルなどの不飽和カルボン酸エステル、一酸化炭素、二酸化硫黄などを例示することができる。これら他の単量体は、例えば0～40重量%、好ましくは0～30重量%の範囲で共重合されていてもよい。

【0009】このようなベースポリマーとしては、190℃、2160g荷重におけるメルトフローレートが0.1～10000g/10分、とくに1～3000g/10分程度のものを使用するのが望ましい。

【0010】本発明においては、このようなエチレン・不飽和カルボン酸共重合体のカルボキシル基の10～100%、好ましくは20～90%、特に好ましくは30～80%を、アルカリ土類金属イオンで中和されたものを用いる。ここにアルカリ土類金属としては、マグネシウム、カルシウム、ストロンチウムなどであり、とくにマグネシウムが最も好ましい。このようなアルカリ土類金属の代わりに、リチウム、ナトリウム、カリウムなどのアルカリ金属や亜鉛などの中和物を用いても、電荷の

長期保持性に優れたエレクトレットを得ることはできない。アイオノマーとしては、成形加工性、成形品の物性等を考慮すると、190℃、2160g荷重におけるメルトフローレートが、0.01~1000g/10分、とくに0.1~500g/10分のものを使用するのが好ましい。

【0011】本発明においては、上記アルカリ土類金属のアイオノマーを単独でエレクトレット化したものをエレクトレットとして使用することもできるが、任意に他の熱可塑性樹脂を配合したものをエレクトレット化の原料として用いてもよい。このような他の熱可塑性樹脂としては、各種ポリエチレン、ポリプロピレン、ポリ-1-ブテン、ポリ-4-メチル-1-ペンテンのようなポリオレフィン、エチレン・酢酸ビニル共重合体、エチレン・(メタ)アクリル酸共重合体、エチレン・(メタ)アクリル酸エステル共重合体、エチレンビニルアルコール共重合体のようなエチレン共重合体、ポリエステル、ポリアミド、ポリカーボネート、ポリスチレン、ABS系樹脂、ポリ塩化ビニル、ポリ塩化ビニリデン、ポリフェニレンオキシド、ポリアセタール、ポリスルホン、ポリイミド、天然ゴム、合成ゴムなどを例示することができる。アルカリ土類金属アイオノマーとこれら他の熱可塑性樹脂の配合比率は、例えば前者1~99重量部、好ましくは50~99重量部に對し、後者99~1重量部、好ましくは50~1重量部である。

【0012】アルカリ土類金属アイオノマーあるいはこれと他の熱可塑性樹脂との配合物をエレクトレット化するにあたり、種々の添加剤を配合することができる。このような添加剤として、酸化防止剤、熱安定剤、紫外線吸収剤、光安定剤、染料、顔料、難燃剤、滑剤、ブロッキング防止剤、可塑剤、粘着付与剤、油、電荷制御剤、

補強材、無機充填剤などを配合することができる。

【0013】エレクトレット化は、公知の方法、例えば熱エレクトレット法、エレクトロエレクトレット法、ラジオエレクトレット法、メカノエレクトレット法などを採用することができる。これらは成形の前に、あるいは成形と同時に、あるいは成形後に行うことができる。また、成形方法、成形条件によっては自発的に帯電することがあり、その様な場合には帯電処理を省略することができる。

【0014】

【発明の効果】本発明のエレクトレットは、高温、高湿下においても、電荷の減衰が少なく、保持性に優れている。したがって繊維状、フィルム状、シート状、チューブ状、管状、粉末状などの形状で利用することができる。また織布、不織布などの形で、或いは他の材料、例えば熱可塑性樹脂と積層した形で利用することができる。かくして得られるエレクトレット成形品は、電荷の長期保存性が優れ、またアイオノマー特有の優れた性質を有するので、防塵フィルター、マイクロホンのような音響素子、計測素子、記憶素子、記録材料、塗料、医療材料などに使用することができる。

【0015】

【実施例】次に実施例により本発明を説明する。なお、実施例、比較例に使用した原料及び各種物性の評価方法は下記のとおりである。

【0016】1. 原料

(1) アイオノマーのベースポリマー

下記表1のものを使用した。

【0017】

【表1】

	共重合体組成		MFR (g/10分)
	不飽和カルボン酸の種類	酸含量 (重量%)	
酸共重合体①	メタクリル酸	9	10
酸共重合体②	メタクリル酸	10	35
酸共重合体③	メタクリル酸	15	60
酸共重合体④	メタクリル酸	20	60

【0018】(2) アイオノマーに配合した熱可塑性樹脂

ポリプロピレン 三井石油化学工業(株)製
MFR: 10g/10分(230℃)

【0019】(3) 中和に用いた有機アミン
NBDA 三井東圧化学工業(株)製

2,5(2,6)-ビス(アミノメチル)ピシクロ[2,2,1]ヘプタ

(2) 表面電荷密度の保持率

(a) 装置

測定機器: 理化学研究所製 表面電荷密度測定機

ン

【0020】2. 物性評価方法

(1) MFR: JIS K7210に準拠、温度190℃、荷重2160g。但し熱可塑性樹脂1については230℃、2160gで評価。

【0021】

荷電装置： 電源：直流荷圧電源（松定プレジション製）

電極：マイナス針状電極、ステンレス板アース電極

【0022】(b) 荷電条件

温度：25℃

電圧：-7kV

荷電時間：30sec

電極間距離：10mm

試験片形状：80×220×0.05mmシート

【0023】(c) 測定方法

フィルムを荷電後、両面をアルミニウム板で挟みショートして不安定な表面電荷を取り除いて、1時間室温にて放置し、表面電荷密度測定器で測定した表面電荷密度を初期値とする。次に、上記サンプルを恒温恒湿槽中、60℃、80%RHにて24時間放置後の表面電荷密度を測定し、これと前記初期値との比率から表面電荷密度の保持率を求め、エレクトレットフィルムの安定性を評価した。

【0024】〔実施例1〕ベント式単軸スクリュウ押出機（スクリュウ径 65mm、L/D=33）中で、酸共重合体②をマグネシウム源によりイオン化し、中和度80mol%のマグネシウムアイオノマーを得た。得られたマグネシウムアイオノマーをインフレーションフィルム成形機にてフィルム成形し、荷電後上記2-(2)の方法に従って表面電荷密度の保持率を測定した。結果を表3に示す。

【0025】〔実施例2、3〕実施例1において、ベースレジンとして酸共重合体②の代わりに、酸共重合体③を用い、表2に示す中和度でマグネシウム源でイオン化して得られたマグネシウムアイオノマーを実施例1と同様に所定形状にフィルム成形し、荷電後、前記の方法によって表面電荷密度の保持率を測定した。結果を表3に示す。

【0026】〔実施例4～6〕実施例3で用いたと同じマグネシウムアイオノマーとポリプロピレン（三井石油化学工業（株）製）を表2に示した配合比率で熔融混練して得られた樹脂組成物を、インフレーションフィルム成形機にてフィルム成形し、上記の方法に従って表面電荷密度の保持率を測定した。結果を表3に示す。

【0027】〔比較例1～4〕ベースレジンとして酸共重合体①～④をそれぞれ用い、マグネシウム源の代わりに亜鉛源によりイオン化して得られた、表2に示す中和度の各亜鉛アイオノマーをインフレーションフィルム成形機にてフィルム成形し、表面電荷密度の保持率を測定したが保持率は実施例と比較して何れも低かった。結果を表3に示す。

【0028】〔比較例5〕ベースレジンとして酸共重合体③を用い、マグネシウム源の代わりにナトリウム源によりイオン化して得られた中和度52mol%のナトリウムアイオノマーをインフレーションフィルム成形機にてフィルム成形し、表面電荷密度の保持率を測定したが、表面電荷密度の保持率は実施例と比較して低かった。結果を表3に示す。

【0029】〔比較例6〕ベースレジンとして酸共重合体③を用い、前記(3)に記載のアミン化合物NBDAによりイオン化して得られた中和度80mol%のアミンアイオノマーを、インフレーションフィルム成形機にてフィルム成形し、表面電荷密度の保持率を測定したが、表面電荷密度の保持率は実施例と比較して低かった。結果を表3に示す。

【0030】

【表2】

	アイオノマー			熱可塑性樹脂	アイオノマー ／熱可塑性樹脂 配合比 (重量)
	ベースレジン	イオン 種	中和度 mol %		
実施例1	酸共重合体②	Mg	80	----	----
実施例2	酸共重合体③	Mg	40	----	----
実施例3	酸共重合体③	Mg	60	----	----
実施例4	酸共重合体③	Mg	60	ポリプロピレン	3/1
実施例5	酸共重合体③	Mg	60	ポリプロピレン	1/1
実施例6	酸共重合体③	Mg	60	ポリプロピレン	1/3
比較例1	酸共重合体①	Zn	18	----	----
比較例2	酸共重合体②	Zn	68	----	----
比較例3	酸共重合体③	Zn	58	----	----
比較例4	酸共重合体④	Zn	40	----	----
比較例5	酸共重合体③	Na	52	----	----
比較例6	酸共重合体③	NBDA	80	----	----

【0031】

【表3】

	表面荷電密度 ($\times 10^{-9} \text{C/cm}^2$)		
	初期値	エージング後	保持率%
実施例1	17.3	12.8	74
実施例2	17.4	11.2	64.4
実施例3	22.4	15.4	69
実施例4	11.4	5.9	51.8
実施例5	11.5	4.8	41.7
実施例6	7.4	4.9	66.2
比較例1	19.4	3.2	16.5
比較例2	20.4	6.7	32.8
比較例3	23	2.6	11.3
比較例4	21.8	2.5	12
比較例5	25.4	1.5	5.9
比較例6	23.3	0.1	0